AMENDMENTS TO THE CLAIMS

This listing of claims replaces all prior versions and listings of claims in this application:

1. (Currently Amended) A method of noncontact dispensing a viscous material onto a surface of a substrate, the method comprising:

providing a jetting valve comprising a valve closure element, a valve seat and a nozzle;

orienting the jetting valve to provide a jetting direction nonperpendicular to the surface of the substrate;

causing the viscous material to flow through the valve seat into the nozzle;

thereafter causing the valve closure element to engage the valve seat to cut off a flow of the viscous material through the valve seat with the viscous material downstream of the valve seat continuing to flow through a dispensing orifice in the nozzle with a forward momentum in the jetting direction;

breaking the flow of the viscous material from the nozzle by using its forward momentum to form a droplet of the viscous material jetted away from the dispensing orifice in the jetting direction; and

applying the droplet of the viscous material to the surface of the substrate, a wetted area on the substrate produced by the droplet being less than a wetted area on the substrate resulting from a jetting direction being perpendicular to the surface of the substrate.

2. (Previously Presented) The method of claim 1 further comprising:

providing a positioner supporting the jetting valve and being operable to move the jetting valve in a first axis of motion;

moving the jetting valve in the first axis of motion with respect to the substrate; and simultaneously,

iterating the steps of causing, thereafter causing, breaking and applying to apply a pattern of the viscous material to the substrate.

3. (Original) The method of claim 2 wherein the first axis of motion is a linear axis of motion and the pattern of the viscous material on the substrate is a linear pattern.

4. (Previously Presented) The method of claim 2 wherein the substrate supports a device having a sidewall separated from the surface of the substrate by a gap, the sidewall being nonparallel to the surface of the substrate and substantially parallel to the first axis of motion, the method further comprising:

orienting the jetting direction oblique to the surface of the substrate and intersecting the substrate at a location in or adjacent to the gap;

moving the jetting valve in the first axis of motion with respect to the substrate; and while moving the jetting valve,

iterating the steps of causing, thereafter causing, breaking and applying to apply a linear pattern of viscous material on the substrate adjacent the gap.

5. (Cancelled)

6. (Previously Presented) The method of claim 4 wherein the device has a sidewall nonparallel to the surface of the substrate and substantially parallel to the first axis of motion, the method further comprising:

orienting the jetting direction oblique to the surface of the substrate and directed generally toward both the surface of the substrate and the sidewall of the device with a projection of the jetting direction on the surface of the substrate being substantially perpendicular to the sidewall of the component;

moving the jetting valve in the first axis of motion with respect to the substrate; and while moving the jetting valve,

iterating the steps of causing, thereafter causing, breaking and applying to apply a linear pattern of viscous material on the substrate adjacent the sidewall of the device.

7. (Original) The method of claim 4 wherein the sidewall of the device is substantially perpendicular to the surface of the substrate.

8. (Previously Presented) The method of claim 2 wherein the positioner is operable to move the jetting valve in a second axis of motion nonparallel to the first axis of motion and the substrate has a device mounted thereon with a first sidewall nonparallel to the surface of the substrate and substantially parallel to the first axis of motion, the device further having a second sidewall nonparallel to the surface of the substrate and substantially parallel to the second axis of motion, the method further comprising:

orienting the jetting direction oblique to the surface of the substrate and directed generally toward both the surface of the substrate and the sidewall of the device with a projection of the jetting direction on the substrate being oblique to the first and second sidewalls;

moving the jetting valve in the first axis of motion with respect to the substrate;

simultaneously moving the jetting valve and iterating the steps of causing, breaking and applying to apply a linear pattern of viscous material on the substrate adjacent the first sidewall of the device;

thereafter, moving the jetting valve in the second axis of motion with respect to the substrate; and while moving the jetting valve in the second axis of motion,

iterating the steps of causing, thereafter causing, breaking and applying to apply a linear pattern of viscous material on the substrate adjacent the second sidewall of the device.

9. (Previously Presented) The method of claim 8 wherein the first sidewall and the second sidewall are substantially perpendicular to the surface of the substrate.

10. (Previously Presented) The method of claim 2 further comprising:

orienting the jetting direction at a first angle with respect to the surface of the substrate;

moving the jetting valve in the first axis of motion with respect to the substrate; while moving the jetting valve,

iterating the steps of causing, thereafter causing, breaking and applying to apply a linear pattern of viscous material to the substrate;

orienting the jetting direction at a second angle with respect to the surface of the substrate;

moving the jetting valve in the first axis of motion with respect to the substrate; and while moving the jetting valve,

iterating the steps of causing, thereafter causing, breaking and applying to apply a linear pattern of viscous material to the substrate.

11. (Currently Amended) A method of noncontact dispensing a viscous material onto first and second opposed surfaces of a substrate, the method comprising:

providing a first jetting valve comprising a first valve closure element, a first valve seat and a first nozzle;

orienting the first jetting valve to provide a first jetting direction nonperpendicular to the first surface of the substrate;

causing the viscous material to flow through the first valve seat into the first nozzle;

thereafter causing the first valve closure element to engage the first valve seat to cut off a first flow of the viscous material through the first valve seat with the viscous material downstream of the first valve seat continuing to flow through a dispensing orifice in the first nozzle with a forward momentum in the first jetting direction;

breaking the first flow of the viscous material from the first nozzle by using its forward momentum to form a first droplet of the viscous material jetted away from the dispensing orifice in the first nozzle in the first jetting direction;

applying the first droplet of the viscous material to the first surface of the substrate, a wetted area on the substrate produced by the first droplet being less than a wetted area on the substrate resulting from a jetting direction being perpendicular to the first surface of the substrate;

providing a second jetting valve comprising a second valve closure element, a second valve seat and a second nozzle;

orienting the second jetting valve to provide a second jetting direction nonperpendicular to the second surface of the substrate;

causing the viscous material to flow through the second valve seat into the second nozzle;

thereafter causing the second valve closure element to engage the second valve seat to cut off a second flow of the viscous material through the first valve seat with-the viscous material downstream of the second valve seat continuing to flow through a dispensing orifice in the second nozzle with a forward momentum in the second jetting direction;

breaking the second flow of the viscous material from the second nozzle by using its forward momentum to form a second droplet of the viscous material jetted away from the dispensing orifice in the second nozzle in the second jetting direction; and

applying the second droplet of the viscous material to the second surface of the substrate, a wetted area on the substrate produced by the second droplet being less than a wetted area on the substrate resulting from a jetting direction being perpendicular to the second surface of the substrate.

12. (Previously Presented) The method of claim 11 wherein the steps of causing and thereafter causing associated with the first jetting valve and the steps of causing and thereafter causing associated with the second jetting valve occur substantially simultaneously.

13. (Cancelled)

14. (Currently Amended) A method of noncontact dispensing a viscous material onto a surface of a substrate having a device mounted thereon with first and second sidewalls being nonparallel with the surface of the substrate, the method comprising:

providing a positioner supporting a jetting valve ~~having~~ comprising a valve closure element, a valve seat and a nozzle directing a viscous material flow in a jetting direction, the positioner being operable to move the jetting valve along X, Y and Z axes of motion, the X and Y axes of motion being substantially parallel to the respective first and second sidewalls, the jetting valve being pivotable in a first angular axis of motion rotatable about the Z axis of motion and a second angular axis of motion rotatable about one of the X and Y axes of motion;

orienting the jetting direction oblique to the surface of the substrate and intersecting the substrate at a location adjacent the first sidewall, the jetting direction being oblique to the first and second sidewalls;

moving the jetting valve along the X axis of motion; and while moving the jetting valve in the X axis of motion,

creating droplets of viscous material by iteratively:

causing the viscous material to flow through the valve seat into the nozzle;

causing the valve closure element to engage the valve seat to cut off a flow of the viscous material through the valve seat with the viscous material downstream of the valve seat continuing to flow through a dispensing orifice in the nozzle with a forward momentum in the jetting direction;

breaking the flow of the viscous material from the nozzle by using its forward momentum to form a droplet of the viscous material jetted away from the dispensing orifice in the nozzle in the jetting direction, and

applying the droplet of the viscous material to the surface of the substrate adjacent the first sidewall, a wetted area on the substrate produced by the droplet being less than a wetted area on the substrate resulting from [[a]] the jetting direction being perpendicular to the substrate.

15. (Currently Amended) The method of claim 14 further comprising:

moving the jetting valve along the Y axis of motion; and while moving the jetting valve along the Y axis of motion,

creating droplets of viscous material by iteratively:

causing the viscous material to flow through the valve seat into the nozzle;

causing the valve closure element to engage the valve seat to cut off a flow of the viscous material through the valve seat with the viscous material downstream of the valve seat continuing to flow through the nozzle with a forward momentum in the jetting direction;

breaking the flow of the viscous material from the nozzle by using its forward momentum to form a droplet of the viscous material, and

applying the droplet of the viscous material to the surface of the substrate adjacent the first sidewall.

16. (Currently Amended) A method of noncontact dispensing a viscous material onto a surface of a substrate comprising:

providing a positioner supporting the jetting valve ~~having~~ comprising a valve closure element, a valve seat and a nozzle directing a flow of viscous material flow in a jetting direction, the positioner being operable to move the jetting valve in a first axis of motion, and the jetting valve being pivotable on the positioner;

pivoting the jetting valve to orient the jetting direction nonperpendicular to the surface of the substrate;

causing the viscous material to flow through the valve seat into the nozzle;

causing the valve closure element to engage the valve seat to cut off a flow of the viscous material through the valve seat with the viscous material downstream of the valve seat continuing to flow through a dispensing orifice in the nozzle with a forward momentum in the jetting direction;

breaking the flow of the viscous material from the nozzle by using its forward momentum to form a droplet of the viscous material jetted away from the dispensing orifice in the nozzle in the jetting direction, and

applying the viscous material droplet to the surface of the substrate, a wetted area on the substrate produced by the viscous material droplet being less than a wetted area on the substrate resulting from a jetting direction being perpendicular to the substrate.

17. (Original) The method of claim 16 wherein the first axis of motion is a linear axis of motion and the jetting valve is pivotable about an angular axis of motion rotatable about the first axis of motion.

18. (Cancelled)

19. (Currently Amended) A method of noncontact dispensing a viscous material onto a surface of a substrate comprising:

providing a jetting valve ~~having~~ comprising a valve closure element, a valve seat and a nozzle directing a viscous material flow in a jetting direction;

pivoting the nozzle to orient the jetting direction of the material flow nonperpendicular to the substrate;

causing the viscous material to flow through the valve seat into the nozzle;

causing the valve closure element to engage the valve seat to cut off a flow of the viscous material through the valve seat with the viscous material downstream of the valve seat continuing to flow through a dispensing orifice in the nozzle with a forward momentum in the jetting direction;

breaking the flow of the viscous material from the nozzle by using its forward momentum to form a droplet of the viscous material jetted away from the dispensing orifice in the jetting direction;[[,]] and

applying a viscous material droplet to the surface of the substrate, a wetted area on the substrate produced by the viscous material droplet being less than a wetted area on the substrate resulting from a jetting direction being perpendicular to the substrate.

20. (Previously Presented) The method of claim 1 wherein orienting the jetting valve further comprises orienting the jetting valve to provide a jetting direction nonperpendicular to the substrate without having to pivot the nozzle.

21. (Currently Amended) The method of claim 1 wherein a device is positioned on the surface of the substrate, the device has a sidewall nonparallel to the surface of the substrate, and wherein applying the droplet of the viscous material to the surface comprises:

depositing the droplet on the surface at a location spaced from the sidewall of the device.

22. (Previously Presented) The method of claim 21 wherein the device is attached to the substrate by solder pads or balls that create a gap between the device and the substrate, and wherein the droplet of viscous material is deposited adjacent the gap below the sidewall of the component.

23. (Previously Presented) The method of claim 22 wherein the device is a semiconductor chip and the substrate is a printed circuit board, and wherein the deposited viscous material moves under the semiconductor chip via capillary action.

24. (Previously Presented) The method of claim 14 wherein the droplet of the viscous material applied to the surface is deposited on the surface without contacting the first sidewall.

25. (Previously Presented) The method of claim 24 wherein the device is attached to the substrate by solder pads or balls that create a gap between the device and the substrate, and wherein the droplet of viscous material is deposited adjacent the gap below the first sidewall.

26. (Previously Presented) The method of claim 25 wherein the device is a semiconductor chip and the substrate is a printed circuit board, and wherein the deposited viscous material moves under the semiconductor chip via capillary action.